FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)
KSN0029	10/089412

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/03464	28 September 2000	29 September 1999

TITLE OF INVENTION

METHOD FOR SECURE CONNECTION OF AN EXTERNAL POWER SUPPLY TO AN OPERATING POWER SUPPLY AND CIRCUIT LAYOUT FOR CARRYING OUT SAID METHOD

APPLICANT(S) FOR DO/EO/US

Jurgen Bruck and Bican Samray

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Check No. 15631 **($890); Return Postcard**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/089412	PCT/DE00/03464	KSN0029

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**	
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**	
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**	
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
	ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**
	Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	15 - 20 =	0	x $18.00	**$0.00**
Independent claims	1 - 3 =	0	x $84.00	**$0.00**
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**
	TOTAL OF ABOVE CALCULATIONS =			**$890.00**
☐	Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.			**$0.00**
	SUBTOTAL =			**$890.00**
	Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +			**$0.00**
	TOTAL NATIONAL FEE =			**$890.00**
☐	Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			**$0.00**
	TOTAL FEES ENCLOSED =			**$890.00**
			Amount to be: refunded	$
			charged	$

a. ☒ A check in the amount of **$890.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **02-0387** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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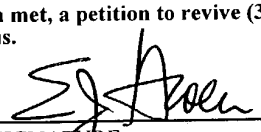


SIGNATURE

Eric J. Groen

NAME

32,230

REGISTRATION NUMBER

March 28, 2002

DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Jürgen Bruck and Bican Samray
Filed	:	PCT/DE00/03464 (September 28, 2000)
Serial No.	:	
Title	:	METHOD FOR SECURE CONNECTION OF AN EXTERNAL POWER SUPPLY TO AN OPERATING POWER SUPPLY AND CIRCUIT LAYOUT FOR CARRYING OUT SAID METHOD
Group/Art Unit	:	
Examiner	:	
Docket No.	:	KSN0029

Honorable Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

In the above-mentioned PCT application, please accept the enclosed application under the national stage pursuant to 35 USC §371 and amend the application as follows:

In the Claims:

Please replace claims 1-15 of the application with claims 1-15 as follows:

1. A method for secure coupling of an external voltage network to an operating network, in particular of a motor vehicle, in which a switching unit with at least one controllable switch is arranged between the operating voltage network and a connecting terminal, the switching unit is connected to a control unit, the connecting terminal is designed for connection of the external voltage network, and the method comprises the following steps:

- generation of a pulse-shaped voltage at the connecting terminal at least when the at least one switch is open,

- in the pulse intervals, measurement of the voltage of the connected external voltage network that is applied to the connecting terminal,
- comparison of the measured values with the voltage or voltages of the operating voltage network,
- controlling the switching unit on the basis of the comparison results.

2. A method according to claim 1, wherein the voltage of the external voltage network is pulse-shaped as well.

3. A method according to claim 1, wherein the control unit, depending on the voltage measured at the connecting terminal, controls the switching unit such that the connecting terminal is connected to an operating voltage network partial system of the same voltage or the connection remains separated.

4. A method according to claim 1, wherein the control unit, depending on the voltage measured at the connecting terminal, controls the switching unit such that the connecting terminal is connected to a battery having the same voltage.

5. A method according to claim 1, wherein the control unit, depending on the voltage measured at the connecting terminal, controls the switching unit such that the connecting terminal is connected to a voltage transformer.

6. A method according to claim 1, wherein in the case of incompatibility of the voltages of the operating voltage network and the external voltage network, the connecting terminal remains separated from the operating voltage network.

7. A method according to claim 6, wherein in the case of reversed polarity of the voltages of the operating voltage network and of the external voltage network, the control unit controls the switching unit such that the polarities of the voltages of the operating voltage network and of the external voltage network are in conformity.

8. A method according to claim 1, wherein the control unit presets at least one voltage range within which the voltage of the external voltage network has to be for the control unit to trigger a connecting switching operation.

9. A method according to claim 1, wherein the voltage at the connecting terminal is evaluated in several pulse intervals before control of the switching unit is effected in case of identical evaluation results.

10. A circuit arrangement for carrying out the method according to claim 1.

11. A circuit arrangement according to claim 10, wherein the at least one controllable switch is a relay.

12. A circuit arrangement according to claim 10, wherein the operating voltage network is the on-board network of a first motor vehicle and the external voltage network is the on-board network of a second motor vehicle.

13. A circuit arrangement according to claim 10, wherein the control unit comprises a pulse generator with high internal resistance, which generates the pulse-shaped voltage.

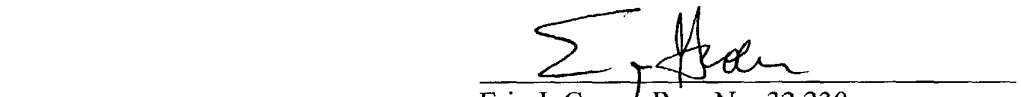
14. A circuit arrangement according to claim 10, wherein a measuring resistor is connected between two terminal means of the connecting terminal.

15. A circuit arrangement according to claim 10, wherein the control unit has a terminal mans for a short-circuit detector.

REMARKS

Applicant respectfully requests that the above preliminary amendment be entered, and that the fees due herewith are calculated using the new claims, not the claims of the PCT application.

Respectfully submitted,



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Group/Art Unit	:	
Examiner	:	
Docket No.	:	KSN0029

Honorable Commissioner for Patents
Washington, D.C. 20231

Sir:

SUPPLEMENTAL AMENDMENT

In the Specification:

Please replace the paragraph beginning at page 7, line 232, with the following rewritten paragraph:

The switching operations as carried out in the concrete application according to Fig. 4 will be summarized hereinafter. If the network of vehicle B is not connected to the connecting terminal VK, there will be no voltage U_{VK} measured at the connecting terminal, with the result that switches Q_1 and Q_2 are open. If the network of vehicle B is connected thereto, the voltage thereof is applied to both poles of connecting terminal VK, i.e. U_{VK} equals U_B. For connecting two vehicle networks, the two voltages do not have to be identical, but they must not differ from each other excessively; i.e. the control unit SG examines whether the voltage U_B is within a certain voltage range that matches either the voltage of the first partial system U_{A1} or the voltage of the second partial system U_{A2}. The voltages U_{A1}, U_{A2} and U_B are dc voltages. If voltage U_B, in terms of its value and polarity, equals voltage U_{A1}, Q_1 will be closed and Q_2 is kept open. If the value of U_B equals that of

U_{A1}, but is of opposite polarity, both switches remain open or are opened, since this embodiment does not provide for automatic correction of the polarity. If voltage U_B corresponds to the voltage U_{A2}, Q_1 is opened and Q_2 is closed. It is ensured by the voltage transformer W that the external voltage network FN, which has a different voltage than the battery with the voltage U_{A1}, nevertheless charges the battery with the voltage U_{A1}. In case of the

Please replace the paragraph beginning at page 8, line 245, with the following rewritten paragraph:

same voltage value, but different polarity, both switches Q_1 and Q_2 are opened again. In all other cases, in particular if the voltage U_B is not applied to connecting terminal VK, i.e. if the voltage at the connecting terminal is zero (in the pulse intervals), both switches remain open. The operating conditions in this respect are summarized in the table indicated hereinafter:

	Q_1	Q_2
$U_{VK} = U_B = U_{A1}$	closed	open
$U_{VK} = U_B = -U_{A1}$	open	open
$U_{VK} = U_B = U_{A2}$	open	closed
$U_{VK} = U_B = -U_{A2}$	open	open
otherwise	open	open
$U_{VK} = 0$	open	open

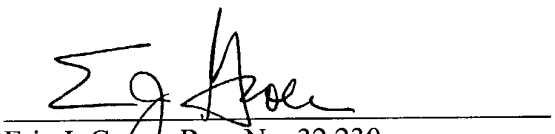
When ac voltage networks are coupled, the circuit arrangement becomes more complex. In addition to the voltage value or voltage amplitude, the frequency and the phase position have to be taken into consideration. Instead of a dc to dc converter, transformers may be used here. It is also conceivable that DC/AC converters or AC/DC converters may be utilized. In coupling three-phase current networks, the phase sequence of the three conductors is to be considered in addition. The coupling method according to the invention, however, remains the same in all cases and only the circuit arrangement needs to be supplemented by corresponding components.

REMARKS

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The attached page is captioned **"Version With Markings to Show Changes Made."**

Applicant respectfully requests that the above Supplemental Amendment be entered.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

The switching operations as carried out in the concrete application according to Fig. 4 will be summarized hereinafter. If the network of vehicle B is not connected to the connecting terminal VK, there will be no voltage U_{VK} measured at the connecting terminal, with the result that switches Q_1 and Q_2 are open. If the network of vehicle B is connected thereto, the voltage thereof is applied to both poles of connecting terminal VK, i.e. U_{VK} equals U_B. For connecting two vehicle networks, the two voltages do not have to be identical, but they must not differ from each other excessively; i.e. the control unit SG examines whether the voltage U_B is within a certain voltage range that matches either the voltage of the first partial system U_{A1} or the voltage of the second partial system U_{A2}. The voltages U_{A1}, U_{A2} and U_B are dc voltages. If voltage U_B, in terms of its value and polarity, equals voltage U_{A1}, Q_1 will be closed and Q_2 is kept open. If the value of U_B equals that of U_{A1}, but is of opposite polarity, both switches remain open or are opened, since this embodiment does not provide for automatic correction of the polarity. If voltage U_B corresponds to the voltage ~~{UA1}~~ **[U_{A2}]**, Q_1 is opened and Q_2 is closed. It is ensured by the voltage transformer W that the external voltage network FN, which has a different voltage than the battery with the voltage U_{A1}, nevertheless charges the battery with the voltage U_{A1}. In case of the

same voltage value, but different polarity, both switches Q_1 and Q_2 are opened again. In all other cases, in particular if the voltage U_B is not applied to connecting terminal VK, i.e. if the voltage at the connecting terminal is zero (in the pulse intervals), both switches remain open. The operating conditions in this respect are summarized in the table indicated hereinafter:

	Q_1	Q_2
$U_{VK} = U_B = U_{A1}$	closed	open
$U_{VK} = U_B = -U_{A1}$	open	open
$U_{VK} = U_B = U_{A2}$	open	closed
$U_{VK} = U_B = -U_{A2}$	open	open
otherwise	open	open
$U_{VK} = 0$	open	open

When ~~{dc}~~ **[ac]** voltage networks are coupled, the circuit arrangement becomes more complex. In addition to the voltage value or voltage amplitude, the frequency and the phase position have to be taken into consideration. Instead of a dc to dc converter, transformers may be used here. It is also conceivable that DC/AC converters or AC/DC converters may be utilized. In coupling three-phase current networks, the phase sequence of the three conductors is to be considered in addition. The coupling method according to the invention, however, remains the same in all cases and only the circuit arrangement needs to be supplemented by corresponding components.

Translation of
PCT/DE00/03464

Description

Method for Secure Coupling of an External Voltage Network to an Operating Voltage Network and Circuit Arrangement for Carrying out Said Method

The invention relates to a method for secure coupling of an external voltage network to an operating voltage network, in particular of a motor vehicle. Furthermore, the invention relates to a circuit arrangement for carrying out said method.

In coupling two voltage networks with each other, care is to be taken that the two voltages are compatible. The parameters of the voltages are their value, their polarity in case of dc voltage and the frequency as well as the phase in case of ac voltage. If there are two voltage networks coupled with each other in which these characteristics are not in conformity, damage in the voltage networks or failure in operation may result.

To avoid damage, it is known to connect fuses in the current path which separate the connection between the voltage networks in case of inadmissibly high current. However, such fuses do not provide protection against too high voltages.

In case of motor vehicles, there is the additional difficulty that different voltage levels will be utilized in the future in the on-board networks of motor vehicles. This constitutes a problem in particular if, in case of failure of the battery of a motor vehicle, a jumper operation is carried out by connecting the on-board network to the on-board network of another vehicle, since there is the risk in that event that different on-board networks are interconnected.

It is an object of the invention to indicate a method that ensures secure coupling of an external voltage network to an operating voltage network, in particular of a motor vehicle, such that damage to the voltage networks is prevented. According to the invention, this object is met by a method for secure coupling of an external voltage network to an operating voltage network, in particular of a motor vehicle, in which a switching unit with at least one controllable switch is arranged between the operating voltage network and a connecting terminal, the switching unit is connected to a control unit, the connecting terminal is designed for connection of the external voltage network and the method comprises the following features:

- generation of a pulse-shaped voltage at the connecting terminal at least when the switch is open,

- in the pulse intervals, measurement of the voltage of the connected external voltage network that is applied to the connecting terminal,

- comparison of the measured values with the voltage or voltages of the operating voltage network,

- controlling the switching unit on the basis of the comparison results.

In addition thereto, a circuit arrangement for carrying out said method is to be indicated.

The method is advantageous since, by way of the pulse-shaped voltage, the information on the inherent voltage is communicated to an external voltage network connected at the connecting terminal while at the same time, i.e. during pulse intervals, the voltage of the external voltage source can be determined.

Furthermore, it is advantageous that a connection between both voltage networks is established only if compatibility thereof has been ascertained by way of a comparison. It is expedient that the connection is denied not only

in case of an error but, optionally, can also be switched to different partial systems of the operating voltage network. In an expedient embodiment, the polarization can be reversed automatically in case of wrong polarity of the external voltage network.

Advantageously, the voltage at the connecting terminal is evaluated in several pulse intervals, before control of the at least one switch is effected, provided that the evaluation results are identical. This provides for enhanced fail-safe design of the system.

An expedient circuit arrangement for carrying out the method is designed such that the controllable switch is a relay.

Further details and developments of the invention are indicated in the dependent claims.

The invention will be explained in more detail hereinafter by way of an embodiment shown in the drawings in which

Fig. 1 shows a representation of the method according to the invention in the form of a block diagram;

Fig. 2 shows the variation with time of the pulse and measurement voltages when the external voltage network employs the method according to the invention as well;

Fig. 3 shows the voltage variations with time when the external voltage network has a constant dc voltage; and

Fig. 4 shows a circuit arrangement for realizing the method according to the invention in the a vehicle environment.

Fig. 4 illustrates an application in which an external voltage network FN is to be coupled to an operating voltage network BN, the two networks being the

electric supply networks of a motor vehicle A and B, respectively. The operating voltage network BN is the network of the first vehicle A, and the external voltage network FN is the network of the second vehicle B. While vehicle B is a vehicle of conventional construction, in which a jumper cable is connected to the on-board voltage directly, vehicle A contains a network with two different partial systems making use of different operating voltages. The first partial system comprises a starter S1 and a battery having a voltage U_{A1}. The second partial system has a conventional on-board network BN1 and a battery having a voltage U_{A2} which is coupled to the first partial system via a voltage transformer W. In addition thereto, the first vehicle A has a control unit SG according to the invention that is connected to the second partial system of vehicle A, the connecting terminal VK and, via control lines, to two controllable switches Q_1 and Q_2. Q_1 is arranged between the connecting terminal and the first partial system and Q_2 is arranged between the connecting terminal VK and the second partial system. Connected between two terminal means of connecting terminal VK is a resistor R_m that serves measurement purposes. Vehicle B has a battery with the voltage U_B, a starter S2 as well as a conventional on-board network BN2. A current measuring means ME_I is connected between the two networks BN and FN.

The control unit SG operates in accordance with the method described with reference to Fig. 1. By way of this figure, the method according to the invention can be elucidated in its general form. An external voltage network FN is connected to a connecting terminal VK. A switching unit SE is connected to the connecting terminal VK as well. Furthermore, there is a connection between switching unit SE and operating voltage network BN. A control unit SG implements the method according to the invention by supplying to the connecting terminal VK a signal generated by a pulse generator IG. This signal is in the form of a pulse-shaped voltage the amplitude of which contains information on the voltage of the operating voltage network BN.

A measuring means ME of the control unit SE continuously monitors the voltage at connecting terminal VK and, in the pulse intervals, measures the voltage applied there. A comparison means VE of the control unit SG compares the measurement results of the measuring means ME to the measured or stored voltages of the operating voltage network BN. In this respect, the operating voltage network BN does not necessarily have a uniform voltage, but may consist of partial systems with different voltages. On the basis of the comparison result, the driving means AE performs controlling of the switching unit SE.

The pulse-shaped voltage generated by pulse generator IG has the effect that a suitable measuring means of the external voltage network FN connected to the connecting terminal VK is capable of recognizing the voltage utilized by the operating voltage network BN. By way of the voltage measured in the pulse intervals, the comparison means VE recognizes whether there is voltage compatibility between the external voltage network FN and the operating voltage network BN. The comparison of the measurement voltages with the comparison values may include both the value of the voltage as well as the polarity or frequency and phase, respectively. Switching unit SE may consist of one or several controllable switches. The number of the switches is dependent upon whether the connection is to remain separated only in case of incompatibility of the voltage networks for example, or whether the external voltage network FN is to be coupled with one of several partial systems of the operating voltage network BN. Additional switches or additional contacts in the switches provided, so that changeover switches are formed, are required if, in case of different polarities of the external voltage network FN and the operating voltage network BN, this is to be corrected automatically.

In a further development of the invention (cp. Fig. 4), the control unit SG has a terminal for a short-circuit detector so that in case of a short, the same is recognized and the connection between external voltage network FN and operating voltage network BN can be separated by means of the switching unit SE. The function of the short-circuit detector may be taken

over by a current measuring means ME_I connected in the current path between the voltage networks. By measuring the current by means of current measuring means ME_I, it is possible in addition to determine the end of a charging operation, namely when the current between the voltage networks drops below a specific threshold value.

Upon separation of a connection, the measurement of the terminal voltage is continued, but it is prevented that the switch or switches are closed again, even if the terminal voltage is within the permissible range. Only when the voltage at the connecting terminal VK drops to zero or below a threshold value, i.e. when the jumper cable SK is released from the connecting terminal VK, does the switching unit SG return to the normal state. This optional locking effect, which constitutes an extension of the method according to the invention, is an additional safety measure that prevents immediate reactivation upon occurrence of an error.

Fig. 2 illustrates the relationship between pulse-shaped voltages, with the voltage U_{IG1} being generated by the pulse generator of a first control unit and the voltage U_{IG2} being generated by the pulse generator of a second control unit, and the voltage U_m measured at the connecting terminal VK. The situation described here is an example in which both networks employ the same method for secure coupling. The period duration T_1 of the pulse voltage U_{IG1} of the first pulse generator is approximately equal to the period duration T_2 of the pulse voltage U_{IG2} of the second pulse generator. As a rule, they differ by a value of δ that is due to the fact that the components used are subject to manufacturing tolerances. The location of the pulses of both voltages thus is shifted relative to each other, i.e. there is a phase shift that continuously changes due to the different period duration. The voltage U_{IG2} is measured in the pulse intervals of U_{IG1}. Thus, a measurement voltage as shown in the lowermost curve in Fig. 2 results for the control unit of the first network. Depending on the phase shift, the width of the measured pulses changes, whereas its amplitude does not. In the extreme case, when both pulse voltages U_{IG1} and U_{IG2} are in phase, only the value zero is measured in the pulse interval of U_{IG1}, i.e. the measurement voltage U_m disap-

pears. In the other extreme case, when the voltages U_{IG1} and 1 U_{IG2} are phase–shifted by 180°, the pulse duration of the measurement voltage U_m corresponds to the pulse interval of U_{IG1}. If there is no second network connected to connecting terminal VK, U_{IG2} disappears, so that the measurement voltage U_m thus is zero as well then. In another operating situation, connecting terminal VK has a network connected thereto that has a constant dc voltage. In that event, the measurement pulses U_m are as long as the duration of one pulse interval of U_{IG1} (Fig. 3). In this manner, only the amplitude of the measurement voltage U_m is utilized for detecting the voltage of network 2. The implementation of the measurement in the pulse intervals is to be understood to the effect that the measurement voltage is evaluated in the pulse intervals only. Whether the measurement is carried out continuously or in the intervals only, is irrelevant for the present invention.

The switching operations as carried out in the concrete application according to Fig. 4 will be summarized hereinafter. If the network of vehicle B is not connected to the connecting terminal VK, there will be no voltage U_{VK} measured at the connecting terminal, with the result that switches Q_1 and Q_2 are open. If the network of vehicle B is connected thereto, the voltage thereof is applied to both poles of connecting terminal VK, i.e. U_{VK} equals U_B. For connecting two vehicle networks, the two voltages do not have to be identical, but they must not differ from each other excessively; i.e. the control unit SG examines whether the voltage U_B is within a certain voltage range that matches either the voltage of the first partial system U_{A1} or the voltage of the second partial system U_{A2}. The voltages U_{A1}, U_{A2} and U_B are dc voltages. If voltage U_B, in terms of its value and polarity, equals voltage U_{A1}, Q_1 will be closed and Q_2 is kept open. If the value of U_B equals that of U_{A1}, but is of opposite polarity, both switches remain open or are opened, since this embodiment does not provide for automatic correction of the polarity. If voltage U_B corresponds to the voltage U_{A1}, Q_1 is opened and Q_2 is closed. It is ensured by the voltage transformer W that the external voltage network FN, which has a different voltage than the battery with the voltage U_{A1}, nevertheless charges the battery with the voltage U_{A1}. In case of the

same voltage value, but different polarity, both switches Q_1 and Q_2 are opened again. In all other cases, in particular if the voltage U_B is not applied to connecting terminal VK, i.e. if the voltage at the connecting terminal is zero (in the pulse intervals), both switches remain open. The operating conditions in this respect are summarized in the table indicated hereinafter:

	Q_1	Q_2
$U_{VK} = U_B = U_{A1}$	closed	open
$U_{VK} = U_B = -U_{A1}$	open	open
$U_{VK} = U_B = U_{A2}$	open	closed
$U_{VK} = U_B = -U_{A2}$	open	open
otherwise	open	open
$U_{VK} = 0$	open	open

When dc voltage networks are coupled, the circuit arrangement becomes more complex. In addition to the voltage value or voltage amplitude, the frequency and the phase position have to be taken into consideration. Instead of a dc to dc converter, transformers may be used here. It is also conceivable that DC/AC converters or AC/DC converters may be utilized. In coupling three-phase current networks, the phase sequence of the three conductors is to be considered in addition. The coupling method according to the invention, however, remains the same in all cases and only the circuit arrangement needs to be supplemented by corresponding components.

Claims

1. A method for secure coupling of an external voltage network to an operating voltage network, in particular of a motor vehicle,

in which a switching unit (SE) with at least one controllable switch (Q_1, Q_2) is arranged between the operating voltage network (BN) and a connecting terminal (VK), the switching unit (SE) is connected to a control unit (SG), the connecting terminal (VK) is designed for connection of the external voltage network (FN) and the method comprises the following features:

- generation of a pulse-shaped voltage (U_{IG1}) at the connecting terminal (VK) at least when the switch/switches (Q_1, Q_2) is/are open,
- in the pulse intervals, measurement of the voltage of the connected external voltage network (FN) that is applied to the connecting terminal (FN),
- comparison of the measured values with the voltage or voltages of the operating voltage network (BN),
- controlling the switching unit (SE) on the basis of the comparison results.

2. A method according to claim 1,
characterized in that the voltage of the external voltage network is pulse-shaped as well.

3. A method according to claim 1,
characterized in that the control unit (SG), depending on the voltage measured at the connecting terminal (VK), controls the switching unit (SE) such that the connecting terminal (VK) is connected to an operat-

ing voltage network partial system of the same voltage or the connection remains separated.

4. A method according to claim 1,
characterized in that the control unit (SG), depending on the voltage measured at the connecting terminal (VK), controls the switching unit (SE) such that the connecting terminal (VK) is connected to a battery having the same voltage.

5. A method according to claim 1,
characterized in that the control unit (SG), depending on the voltage measured at the connecting terminal (VK), controls the switching unit (SE) such that the connecting terminal (VK) is connected to a voltage transformer (W).

6. A method according to claim 1,
characterized in that, in case of incompatibility of the voltages of the operating voltage network (BN) and the external voltage network (FN), the connecting terminal (VK) remains separated from the operating voltage network (BN).

7. A method according to claim 6,
characterized in that, in case of reversed polarity of the voltages of the operating voltage network (BN) and of the external voltage network (FN), the control unit (SG) controls the switching unit (SE) such that the polarities of the voltages of the operating voltage network (BN) and of the external voltage network (FN) are in conformity.

8. A method according to claim 1,
characterized in that the control unit (SG) presets at least one voltage range within which the voltage of the external voltage network (FN) has to be for the control unit (SG) to trigger a connecting switching operation.

9. A method according to claim 1,
characterized in that the voltage at the connecting terminal (VK) is evaluated in several pulse intervals before control of the switching unit (SE) is effected in case of identical evaluation results.

10. A circuit arrangement for carrying out the method according to any of claims 1 to 9.

11. A circuit arrangement according to claim 10,
characterized in that the at least one controllable switch (Q_1, Q_2) is a relay.

12. A circuit arrangement according to claim 10 or 11,
characterized in that the operating voltage network (BN) is the on-board network of a first motor vehicle and the external voltage network is the on-board network of a second motor vehicle.

13. A circuit arrangement according to claim 10,
characterized in that the control unit (SG) comprises a pulse generator (IG) with high internal resistance, which generates the pulse-shaped voltage.

14. A circuit arrangement according to claim 10,
characterized in that a measuring resistor (Rm) is connected between two terminal means of the connecting terminal (VK).

15. A circuit arrangement according to claim 10,
characterized in that the control unit (SG) has a terminal means for a short-circuit detector (ME_I).

Abstract

The invention relates to a method for secure coupling of an external voltage network to an operating voltage network, in particular of a motor vehicle. A switching unit (SE) is arranged between the operating voltage network (BN) and a connecting terminal (VK). The switching unit (SE) is connected to a control unit (SG) and the connecting terminal (VK) is designed for connection of the external voltage network (FN). Said method for secure coupling comprises the following features: generating a pulse-shaped voltage at a connecting terminal (VK) at least when the switch is open; in the pulse intervals, measurement of the voltage of the connected external voltage network that is applied to the connecting terminal (VK); comparison of the measured values with the voltage(s) of the operating voltage network (BN); controlling the switching unit (SE) on the basis of the comparison results. The invention also relates to a circuit arrangement for carrying out said method.

Docket No.
KSN0029

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD FOR SECURE CONNECTION OF AN EXTERNAL POWER SUPPLY TO AN OPERATING POWER SUPPLY AND CIRCUIT LAYOUT FOR CARRYING OUT SAID METHOD

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on **March 28, 2002** as United States Application No. or PCT International Application Number **10/089,412**

and was amended on **March 28, 2002**

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
DE 19946733.1	**Germany**	**29 September 1999**	☐
(Number)	(Country)	(Day/Month/Year Filed)	
(Number)	(Country)	(Day/Month/Year Filed)	☐
(Number)	(Country)	(Day/Month/Year Filed)	☐

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(Application Serial No.)	(Filing Date)

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PCT/DE00/03464	28 September 2000	Pending
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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